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RESEARCH for FARMERS

FALL 1965

ALFALFA STEM NEMATODE

MODE D'EXPLOITATION DE L'HERBE

SWATHER AND COMBINE LOSSES WITH WHEAT

GRAIN AND PASTURE FOR FATTENING STEERS

OIL SPRAYS FOR INSECT AND MITE CONTROL

CANADA DEPARTMENT OF AGRICULTURE

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Cover Photo—Studies of swather and combine losses with wheat revealed interesting facts. (see story p. 8)

NOTES & COMMENTS

At Lethbridge, Hawn and Hanna (p. 3) have found that varieties of alfalfa develop symptoms of either bacterial wilt or stem nematode, or both, depending on susceptibilities. In repeated greenhouse tests, they have shown Grimm to be completely susceptible to stem nematodes and wilt, Beaver to be highly susceptible to stem nematodes and resistant to bacterial wilt, Vernal to be slightly resistant to stem nematodes and highly resistant to bacterial wilt, and Lahontan to be highly resistant to both. They also report that in the course of screening diseased populations of plants for stem-nematode resistance, they uncovered some previously unrecorded sources of resistance, one of which is the variety Vernal itself that appears to contain a small but consistent percentage of resistant plants. The authors point out that since Vernal already has excellent wilt resistance and a satisfactory degree of winter hardiness in southern Alberta, plants selected for nematode resistance could provide a useful short-cut to the breeding objective. As a result of their discovery, a group of these resistant plants is being evaluated in a field test and could form the nucleus of a nematode-resistant Vernal strain if their peformance is at least equal to that of Vernal as a whole.

* * *

Lionel Lachance (p. 6) reports on results of experiments at Lennoxville in grass management practices .... Dodds (p. 8) reveals some interesting findings at Swift Current concerning the relative importance of swather and combine losses with wheat .... From Lethbridge, Clark (p. 10) writes about grain and pasture for fattening steers and comes to grips with the basic problem in efficient utilization, namely increased animal requirements and decreased productivity of pastures as the season advances .... Madsen (p. 12) reports on results obtained at Summerland from using oil sprays for insect and mite control on apples and pears; he adds that research is continuing on the use of oils, especially as safe, effective foliage sprays.

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E. J. HAWN and M. R. HANNA

Grimm alfalfa seedling infested with stem nematode.

THE ALFALFA STEM NEMATODE

The alfalfa stem nematode *Ditylenchus dipsaci* (Kühn) is a relatively new threat to the alfalfa crop in the irrigated areas of south Alberta. It enters the crown buds of alfalfa plants during the cool periods of the growing season. In susceptible varieties it causes swelling of the buds and shortening and distortion of the stems and leaves, thus reducing hay yield and general plant vigor. Alfalfa seedlings too, are attacked between seed germination and emergence from infested soil. Infested seedlings of susceptible varieties show a characteristic swelling at the junction of the seed leaves and the stem. The amount of damage the nematode does to the growing point of the seedling will largely determine how far the seedling will develop.

At the CDA Research Station, Lethbridge, Alta., we have been investigating, since 1959, the relationship between the alfalfa stem nematode and bacterial wilt of alfalfa. Grimm, a variety that is highly susceptible to both stem nematodes and bacterial wilt was chosen as a host. In a series of greenhouse experiments three-month old plants were inoculated with stem nematodes only, with bacterial wilt only, and with combined inoculum to evaluate the role of the nematode as a vector of the wilt bacterium. Each test was divided into a wounded and an unwounded series, i.e., in one the roots were cut with a knife to facilitate entry of wilt bacteria whereas the sole source of wounding in the other series was the nematode.

The data (Table 1) showed conclusively that the stem nematode had carried the wilt bacteria into the alfalfa plants in the unwounded series of treatments (Table 1 (d)) causing a six-fold increase in bacterial wilt rating over those shown by either the nematode inoculated (b) or bacterial-wilt inoculated treatments (c). The slight (0.1 average) amount of bacterial wilt in nematode inoculated plants (Table 1 (b)) was the result of inoculating with nematodes taken from field plants that showed symptoms of both bacterial wilt and stem nematodes. Nematodes did not appreciably aid in the development of bacterial wilt in the wounded series (II) because an excellent avenue of entry was already provided.

We have found, by using differential staining procedures, that wilt bacteria are carried in the striations of the nematode's outer body layer, the cuticle. Thus stem nematodes that emerge from

Dr. Hawn is a plant pathologist and Dr. Hanna a plant breeder at the CDA Research Station, Lethbridge, Alta.

TABLE 1—EFFECT OF NEMATODE (*D. DIPSACI*) ON BACTERIAL WILT DEVELOPMENT IN GRIMM ALFALFA IN THE GREENHOUSE

Treatments	Average[1] bacterial wilt[2]	Percentage wilt-infected plants	Percentage nematode-infected plants
I. UNWOUNDED SERIES			
a) Control	0.0	0.0	0.0
b) Nematode inoculation	0.1	3.9	81.2
c) Bacterial wilt inoculation	0.1	3.8	0.0
d) Nematode inoculation plus bacterial wilt inoculation	0.6	27.0	81.9
II. WOUNDED SERIES			
e) Control	0.1	3.0	0.0
f) Nematode inoculation	0.2	13.9	86.1
g) Bacterial wilt inoculation	2.2	88.8	0.0
h) Nematode plus bacterial wilt inoculation	2.3	82.1	75.3

[1]Average of 4 tests.

[2]Bacterial wilt was assessed on top and root symptoms using a numerical rating of 0 to 5.

wilt-infected alfalfa plants and are transported by splashing water or irrigation water to healthy plants, carry the alfalfa wilt bacteria with them. Varieties of alfalfa develop symptoms of one or both diseases depending on their susceptibilities. Repeated greenhouse tests have shown Grimm to be completely susceptible to stem nematodes and wilt, Beaver to be highly susceptible to stem nematodes and resistant to bacterial wilt, Vernal to be slightly resistant to stem nematodes and highly resistant to bacterial wilt, and Lahontan to be highly resistant to both.

Another deleterious effect of stem nematode infestation is its influence on cold-hardiness. Field observations have indicated that when our recommended varieties become infested they are no longer as resistant to winter-killing as healthy plants. See Table 2. Total survival of Lahontan was due to stem nematode resistance and the mild winter weather.

As we have already indicated, different varieties of alfalfa vary in their reaction to the stem nematode all the way from completely susceptible to highly resistant. Resistant varieties appear to offer the most effective and economical means of meeting the disease threat; they have proved very successful in other areas where the stem nematode disease occurs.

TABLE 2—INFLUENCE OF STEM NEMATODE INFESTATION ON WINTER SURVIVAL OF FOUR ALFALFA VARIETIES IN 1964

Variety	Varietal reaction to stem nematode	Treatment	Percent survival
Grimm		Control	97.5
Grimm	Highly susceptible	Nematode	50.0
Vernal		Control	98.7
Vernal	Slightly resistant	Nematode	73.7
Beaver		Control	96.3
Beaver	Highly susceptible	Nematode	38.7
Lahontan		Control	100.0
Lahontan	Highly resistant	Nematode	100.0

(A) Healthy, and (B) stem-nematode infested plants above were taken from field plots shown at right.

The advantages of resistant varieties have been evident in several field tests at Lethbridge. In one test the total seasonal hay yields of six alfalfa varieties in the second harvest year were compared. Plants in half of the plots of each variety had been inoculated with stem nematodes in the spring of the previous year, the remaining half had not been inoculated. There was no yield reduction due to the presence of the nematode in the inoculated plots of the two resistant varieties Talent and Lahontan. However, there was a reduction of 38-42 per cent in forage yields of the inoculated plots of the three susceptible varieties Ladak, Beaver, and Grimm. Yield of the partially-resistant variety Vernal was reduced 24 per cent by the presence of the nematode.

Unfortunately, none of the existing resistant varieties are of direct usefulness in south Alberta or other irrigated areas in the Prairie Provinces where the stem nematode may pose a threat to alfalfa production. For example, neither of the two resistant varieties, Lahontan and Talent, is dependably hardy. Talent has the added disadvantage of being highly susceptible to bacterial wilt.

In 1961 a breeding program was started at Lethbridge in an attempt to combine stem-nematode resistance and bacterial-wilt resistance in a variety with the necessary level of winterhardiness. One of the most obvious lines of approach was to utilize a backcrossing program to introduce stem nematode resistance into one or more of the currently recommended varieties having other desirable characteristics. Two such varieties are Beaver and Vernal. Lahontan and several other sources of nematode resistance were used as parents in crosses with these two varieties. The resulting hybrids were in turn crossed to Beaver and Vernal plants, giving rise to the first backcross generation. Plants of this first backcross generation have been crossed once again to the recurrent parents to produce the second backcross generation. This is the point we have reached in this phase of the breeding program. One or two more backcrosses may be needed before we reach the objective of a variety with essentially the same characteristics as Beaver or Vernal but with the single added advantage of a high level of stem-nematode resistance. So far no difficulties have been experienced in recovering resistance to both bacterial wilt and stem nematode in the backcross generations, and there is no reason to believe that the required level of winterhardiness and other desirable agronomic features cannot be regained also.

In the course of screening diseased populations of plants for stem-nematode resistance, we uncovered some previously unrecorded sources of resistance. One of these is the variety Vernal itself, which appears to contain a small but consistent percentage of resistant plants. Straight selection for such resistant plants within Vernal has been carried on as an adjunct to the backcrossing program. Since Vernal already has excellent wilt resistance and a satisfactory degree of winterhardiness in southern Alberta, plants selected for nematode resistance could provide a useful short-cut to the breeding objective. A group of these resistant plants is being evaluated in field test and could form the nucleus of a nematode-resistant Vernal strain if their performance is at least equal to that of Vernal as a whole. ●

LE MODE D'EXPLOITATION INFLUENCE LA PRODUCTION ET LA COMPOSITION DE L'HERBE

LIONEL LACHANCE

Depuis plus de 10 ans, la Section de phytotechnie de la Ferme expérimentale de Lennoxville poursuit des recherches concernant les divers facteurs qui influencent les rendements des plantes fourragères. Parmi ces facteurs, on peut citer la nature des plantes-abris, les doses, les dates et les modes de semis, les associations de plantes et enfin, le mode d'exploitation. Ce dernier facteur a fait l'objet de plusieurs études, tant en Amérique qu'en Europe. La plus connue est celle du professeur André Voisin de France, qui lui a consacré plusieurs chapitres dans son volume intitulé: «Productivité de L'Herbe».

A Lennoxville, les recherches sont centrées autour de quatre graminées fourragères dont la culture est répandue dans la province de Québec. Ce sont le mil ou fléole, le brome, le dactyle et l'alpiste roseau. Le but de nos travaux était de connaître, non seulement le comportement de ces graminées, mais surtout de mesurer leur productivité et leur composition chimique quand on les soumettait à divers modes d'exploitation. Pour réaliser cette étude, les graminées ont été ensemencées en culture pure, soumises à trois régimes d'exploitation, soit 2, 3 et 4 coupes par année et prélevées à 1½ pouce et à 3 pouces du sol. A chaque coupe, des échantillons ont été prélevés afin de déterminer la matière sèche et la composition chimique.

M. Lachance, de la Ferme expérimentale de Lennoxville, est spécialisé en graminées.

Le stade de développement de la plante, au moment de la récolte, a varié selon le régime d'exploitation. Ainsi, dans le régime de deux coupes, la première a été prélevée alors que la plante atteignait la floraison et la seconde au stade feuillu, c'est-à-dire, alors que la plante atteignait de 6 à 8 pouces de hauteur. Dans le régime de trois coupes, la première a été faite au stade de la montaison ou au stade du début de l'épiaison (brome et dactyle); la deuxième, à l'état feuillu ou au début de la montaison et enfin la troisième, à l'état feuillu. Enfin, dans le régime de quatre coupes, les graminées ont été récoltées à l'état feuillu. Quant aux périodes de repos entre les coupes, elles ont été dans le premier régime de 9 semaines; dans le second, de 6 à 8 semaines, tandis que dans celui de 4 coupes, elles ont été de 5 semaines entre la première et la deuxième, 4 semaines entre la deuxième et la troisième, et de 6 semaines entre la troisième et la quatrième. Comme fumure, lors du semis, on a appliqué 400 livres de 4-24-20 à l'acre; et comme fumure de maintien au cours des années subséquentes, 150 livres de nitrate d'ammoniaque au printemps et 300 livres de 4-24-20 à l'automne.

La productivité des graminées pendant les 4 années d'exploitation a varié selon les espèces, la fréquence des coupes et enfin, la hauteur des prélèvements. En effet, indépendamment des hauteurs et des fréquences de coupes, le dactyle, plante précoce, a fourni les rendements les plus faibles (3620 liv. M.S. à l'acre); alors que le mil, plus tardif, produisait plus (4845 liv.) que les autres graminées. De plus, les coupes fréquentes (3, 4 coupes) ont réduit la production d'herbe par rapport au régime de 2

L'auteur examine une parcelle d'essai.

coupes, soit 3664 liv. en regard de 5320. Enfin, les prélèvements à 1½ pouce du sol ont permis d'obtenir, dans les quatre graminées, des rendements supérieurs (4520 lb.) à ceux de 3 pouces (3430 liv.). La fréquence des coupes a influencé la composition chimique, alors que la hauteur des prélèvements n'a que légèrement modifié les teneurs des divers éléments. Les protéines brutes, dans le régime de deux coupes, ont été, en général, faibles (9.8%) par rapport aux régimes de trois et de quatre coupes (14.9%). On a observé que l'alpiste roseau avait fourni le plus haut pourcentage de protéines (13.8%) suivi de près par le brome, le dactyle et enfin, le mil. Dans le régime de 3 coupes, la teneur du dactyle en protéines à été légèrement inférieure à celle des trois autres graminées. Dans le régime de quatre coupes, l'alpiste roseau s'est placé au premier rang, suivi du brome, du dactyle et du mil.

Les teneurs en phosphore ont également été influencées. Ainsi, le dactyle, dans le régime de 2 coupes, a été beaucoup plus riche en phosphore que les trois autres graminées. La même tendance s'est manifestée dans les régimes de 3 et 4 coupes. Quant aux teneurs en potassium, elles ont varié selon les espèces et la fréquence des coupes; la teneur du mil n'a à peu près pas varié dans les trois régimes; chez le brome, le dactyle et l'alpiste roseau, elle a été plus faible dans le régime de 2 coupes et plus forte dans le régime de 4 coupes; au total, c'est le dactyle qui a été le plus riche en potassium dans les trois régimes.

Les teneurs en calcium ont varié dans le régime de deux coupes. Ainsi, les brome et dactyle ont été légèrement supérieurs au mil et à l'alpiste roseau. Dans les régimes de trois et quatre coupes, les teneurs ont été à peu près les mêmes.

Les teneurs en matières grasses ont varié dans le régime de deux coupes et c'est le dactyle qui s'est montré le plus riche. Dans les deux autres régimes, les teneurs ont été comparables sauf dans le cas du dactyle qui a été bien supérieur aux autres graminées.

Les teneurs en cellulose brute ont varié à l'inverse des coupes. Ainsi, dans le cas des coupes fréquentes (3 et 4 coupes) les teneurs ont été plus faibles; le brome a atteint le plus fort pourcentage.

Les teneurs en cendre ou matières minérales totales ont également varié en fonction des espèces et des coupes. Ainsi, le dactyle a été le plus riche en cendre suivi de près par l'alpiste roseau et le brome. En outre, plus les coupes étaient fréquentes, plus fortes étaient les teneurs en cendre; la même tendance a été observée chez les quatre graminées.

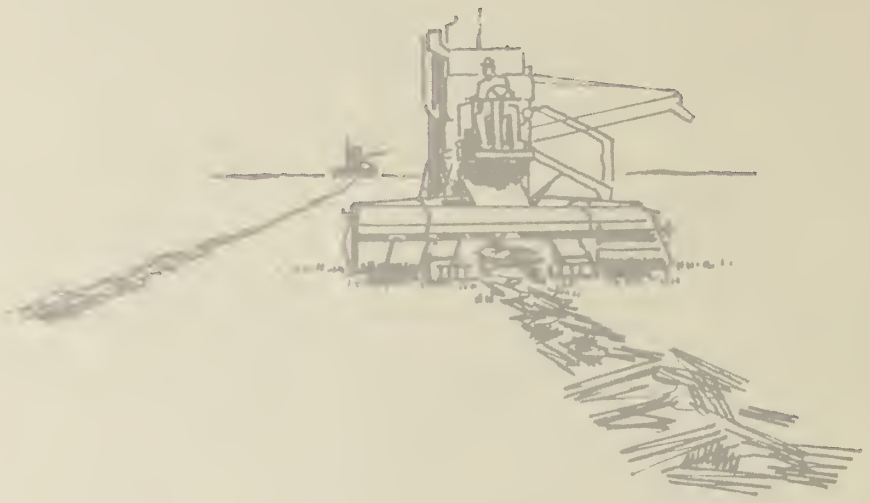
La composition chimique a été le reflet fidèle de l'âge de la plante au moment de la récolte. C'est ainsi que les plantes, dans le régime de deux coupes, étaient beaucoup plus riches en tiges qu'en feuilles lors de la première coupe; et conséquemment, les teneurs en protéines ont été plus faibles de même que celles des principaux éléments minéraux, P, K, Ca. Par contre, les teneurs en cellulose brute ont été beaucoup plus fortes. Les plantes récoltées trois fois et quatre fois au cours de la saison, étaient plus jeunes et plus feuillues et en conséquence, possédaient des teneurs beaucoup plus fortes en protéines, en éléments minéraux et en matières grasses.

Il ressort de cette étude, que le mil indépendamment des hauteurs et des fréquences de coupes, a fourni les rendements les meilleurs. De plus, le régime de deux coupes a favorisé une production plus forte que celle de trois et quatre coupes chez les quatre graminées. Quant au prélèvement à 1½ pouce du sol, il a permis d'obtenir des rendements légèrement supérieurs. Quant à l'influence du mode d'exploitation sur la composition chimique, on peut dire que la hauteur de coupe n'a pas influencé d'une façon significative la matière organique (protéines brutes, cellulose brute et matières grasses) ni la matière minérale (P, K et Ca); mais que les coupes les plus fréquentes ont eu pour résultat, des teneurs plus élevées en protéines, phosphore, potassium et calcium, en regard des coupes moins fréquentes.

En bref, le cultivateur, qui récolte des graminées pour le foin, l'ensilage ou le pâturage, obtient des herbages de valeurs alimentaires différentes. Comme foin (2 coupes), les graminées sont récoltées alors qu'elles sont à un stade de développement près de la maturité; et en conséquence, les teneurs en protéines et en éléments minéraux sont en général plus faibles. Comme ensilage (3 coupes), elles ont une meilleure composition chimique; comme pâturage, elles possèdent la meilleure valeur alimentaire à cause du fort pourcentage de feuilles.

Ce travail fait partie d'une étude plus vaste, comprenant des recherches sur la productivité des mêmes graminées au cours de divers cycles de végétation. A la suite de tous ces travaux, il sera possible de définir le rythme de croissance des graminées et la répartition de leur production tout au cours de la saison. Enfin il s'agira de préparer des calendriers de paissance qui aideront les cultivateurs à obtenir un rendement maximum d'herbages nutritifs. ●

SWATHER AND COMBINE LOSSES WITH WHEAT



M. E. DODDS

Early studies of grain losses at harvest time conducted at Swift Current revealed that they could be divided into two classes. The first class is the natural loss to the standing crop such as shattering from wind and rain, the loss caused by insects, birds, and animals, and the inherent weaknesses of the variety. The second class is the mechanical loss caused by the harvesting equipment.

Tests to determine the relative importance of these losses were conducted during the harvest seasons of 1961 to 1964, inclusive. Plots of Chinook wheat were sampled daily prior to swathing to determine the natural loss, and after swathing to obtain a natural plus swathing loss. Subtracting one from the other gives the loss caused by the reel and cutter bar. Sampling consisted of recording the weight of kernels on the ground, plus those in the heads of broken or bent stems, in grams per square foot. These weights were then converted to bushels per acre. Kernel moisture content at the time of swathing was used as a measure of the maturity of the crop. The swath was picked up and threshed with a combine when the kernel moisture content reached 14.5 percent. The area on which the swath had been laid was then sampled and the pick-up loss was determined. All the grain, broken kernels, and unthreshed heads passing through the combine were collected at the rear of the machine and weighed to give a threshing loss. The trends of the various losses in relationship to kernel moisture content of the grain are shown in the accompanying graph.

The author is a specialist in harvest equipment engineering at the CDA Experimental Farm, Swift Current, Sask.

The natural loss is of particular interest. This loss increases rapidly as the maturity of the crop advances until it becomes the highest of all the losses. It begins to increase rapidly in the range of 40 to 34 per cent kernel moisture and, by the time the crop is ready for straight combining, the natural loss could be 0.8 bushels per acre. Weather conditions or insects can further increase this loss.

The swathing loss, or the reel and cutter bar loss, applies to both swathing and straight combining and is present even at high moisture content when some shattering is caused by the action of the reel. This loss increases as the grain matures but appears to level off to approximately 0.45 bushels per acre at a moisture content of 15 per cent.

The natural and reel and cutter bar losses are added together and are shown in the graph to illustrate the loss that may be expected when a crop is cut at different stages of maturity. This loss, in the study considered here, reached a high of 1.24 bushels per acre at a kernel moisture content of 10 per cent.

The pick-up loss does not have any direct relationship to the moisture content of the grain at the time it was swathed but does reflect the condition of the kernels after a period of maturing in the swath. Crops swathed at very high kernel moisture contents are not mature and the light weight, shrunken kernels are shattered by the mechanical action of the pick-up. This loss decreases slowly as the grain swathed at successively later stages of maturity is picked up, and becomes a minimum of 0.3 bushels per acre in the range of 32 to 22 per cent kernel moisture. There is then a slight increase in the pick-up loss as grain swathed at more mature stages is handled.

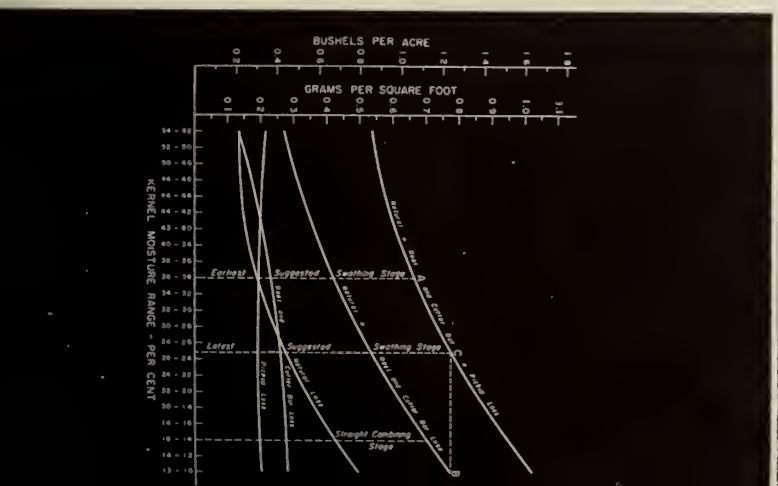
Adding the natural loss, reel and cutter bar loss, and the pick-up loss presents a picture of the total loss that may be expected when swathing and picking-up a wheat crop. At a moisture content in late maturity this may amount to 1.65 bushels per acre.

The threshing loss, or the losses at the cylinder and concaves, the straw walkers, and the shoe, is not presented in the accompanying graph. This loss depends on many factors such as the condition of the grain and straw, the mechanical adjustments of the combine, the through-put (pounds of straw and chaff per minute) and the physical operation of the machine. It has been reported by the Agricultural Machinery Administration, Saskatchewan Department of Agriculture, that the capacity of a combine should be based in terms of grain loss, this loss being affected to a great extent by the losses over the straw walkers. Thus, the ability of the combine to handle straw and chaff is a measure of its capacity, since the walker loss increases rapidly as the through-put increases, and may amount to several bushels per acre. It was noted, in tests with a carefully adjusted and operated combine at Swift Current, that the threshing loss may be less than 0.1 bushels per acre, whereas a careless setting of the cylinder and concaves, wind, and sieves increased this loss to 0.5 bushels per acre.

It has been suggested by earlier research done at this Experimental Farm that the earliest stage of maturity at which wheat could be swathed is represented by a kernel moisture content of 35 per cent. The vertical line in the graph to point A represents this stage of maturity. This shows that for the four years under study, the losses in a wheat crop that was swathed and picked-up with a combine were about 1.05 bushels per acre. If the same crop were left until mature enough to straight combine the losses ranged from 1.13 to 1.25 bushels per acre at B. It is assumed that this is the maximum loss that would be accepted when straight combining. Then, a horizontal line drawn to the left from point B would intersect the top curve at point C to give an equal loss if the crop had been swathed. This would indicate that if the pick-up loss was to be avoided, it would not be a good harvesting practice to swath wheat after the kernel moisture content reached 25 per cent. There are, however, some crop conditions which will affect such a decision. Swathing at a stage of maturity later than 25 per cent kernel moisture will be justified if there is a heavy growth of green weeds which would interfere with straight combining; if the field were infested with insects, such as sawfly which becomes most active about this stage of maturity; if the crop had become tangled or lodged by wind; or if the weather conditions were such that the maturing and drying of the standing crop were prolonged. The time in days between these suggested stages of maturity is not indicated in the graph, but experience and results of tests have shown that points A and C are about 6 days apart, and the lapse between points C and B is about 3 days.

This study reveals that the natural loss is the largest single loss of those observed. It is further realized that this loss can increase during periods of high winds, insect infestation, or when the standing crop is subjected to alternate wetting and drying. This loss may be minimized by swathing at a kernel moisture content of about 35 per cent. Swathing after the crop has reached 25 per cent kernel moisture subjects the crop to an additional pick-up loss, as well as introducing an extra field operation to a crop that could be straight combined three or four days later. The exceptions to late swathing would be in crops infested with weeds or insects, or where the grain has been lodged. The threshing loss is influenced by grain conditions at the time of combining, combine adjustment, yield of grain, straw and chaff, and by the mechanical operation of the combine. ●

Trends of various losses related to kernel moisture content of the grain.



The ability of a combine to handle straw and chaff is a measure of its capacity.

This article deals with the basic problem in efficient utilization, namely increased animal requirements and decreased productivity of pastures as the season advances.

GRAI
AND PASTUR
FOR FATTENIN
STEERS

R. DAVID CLARK

Supplemental feeding of grain to steers being fattened on irrigated pasture increases their average daily gain, net profit per steer, and net income per acre when compared to steers on pasture alone. We base this conclusion on a two-year trial at the CDA Research Station, Lethbridge, Alta. Our results, of course, were obtained under normal price conditions.

Fluctuations in forage growth during the grazing season markedly affect the quantity and quality of nutrients available to animals. Overstocked pasture may give high output per acre but output per animal will be low. Understocking also can cause low production per animal because the forage is not utilized at its proper stage of growth. For maximum production, both animals and pasture must have high production capacity.

In our investigations we found that good irrigated pastures produced approximately 6,000 pounds of dry matter per acre each year. The production of this material varied from approximately 70 lb. of dry matter per acre per day in May and June to 24 lb. per day in August and September.

The daily feed requirement of an animal depends upon its size, age, sex, and production. For example a 600 lb. yearling steer gaining 2.2 lb. per day requires 18 lb. of dry matter per day. At 800 lb. the requirement would be 24 lb. to achieve the same rate of gain. In the spring, forage is being produced at a rate sufficient to carry 4 steers per acre, but by autumn there is only enough for 1 steer per acre. As the season advances, it is usually necessary to increase the availability of feed in one of the following ways:

- Adjust the stocking rate. Excess steers can be sold, placed on other pasture, or put in a feedlot for finishing.
- Increase the pasture size. Some of the area may be cut for hay early in the season and the aftermath may be grazed.
- Provide supplemental feed. This can be grain, silage, or roughage.

The author is an animal husbandman, CDA Research Station, Lethbridge, Alta.

To show the effect of supplemental feeding, three groups of yearling steers were grazed on irrigated pasture from mid-May until September. One group of steers received no grain. Beginning in mid-June, we fed a second group increasing amounts of ground barley until the steers were on full feed during the last month of the pasture season. We kept the third group on full feed throughout the pasture season. During the last month of the season, the second and third groups were eating up to 18 lb. of barley per head per day. The number of steers in each group varied so that the grass was utilized equally in each pasture.

Our results from this 2-year study are given in the table.

The average daily gain was approximately six-tenths of a pound greater for the steers receiving grain than for those on pasture only. Profit per steer varied little between steers receiving grain for the entire season and those given grain for part of the season, but the profit per acre was increased because more steers were carried.

Both feed and total costs per pound of grain were lowest for the animals on pasture only. Total costs include such items as buying, selling, trucking charges, feeding grain, death losses, interest on money invested, and an overhead charge of 5 cents per head per day.

The steers that received grain had sufficient finish to grade in the top two grades. The steers on grass alone graded mainly commercial or standard.

The costs of feed per pound of gain and per steer were greater for the steers that received grain, but the increase in weight gains and value per pound more than compensated for the increased cost. Profit per steer was greatest when grain was fed, and because more steers were carried per acre the profits per acre also were higher.

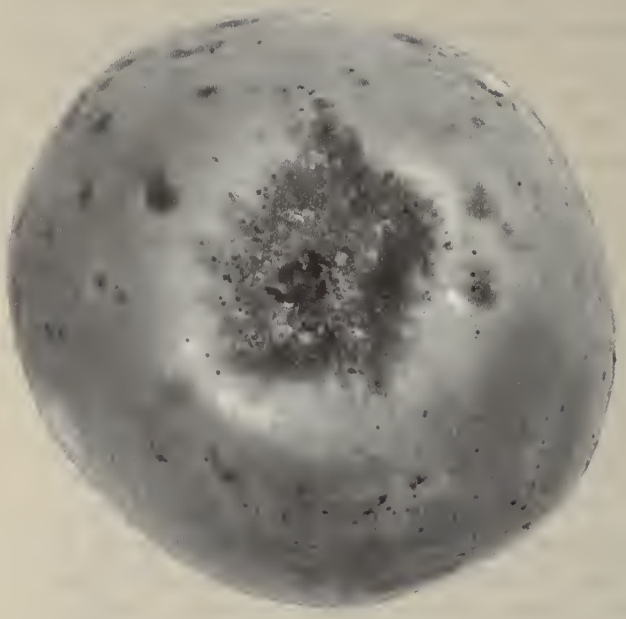
Feeding of grain to steers on pasture offers many advantages. Pastures stocked to capacity in the spring can maintain the same number of animals when pasture growth declines if grain is being fed in increasing amounts. Animals can be marketed directly off grass as fat cattle. If a short drylot period is needed, the animals are accustomed to grain. More cattle can be carried per acre. ●

TABLE 1. SUMMARY OF TWO-YEARS' STUDY

	GROUP		
	I No grain	II Part grain	III Full grain
Number of steers	20	31	40
Steers per acre	2.5	3.9	5.2
Av. weight start (lb.)	661	659	659
Av. weight off (lb.)	940	1000	1021
Av. daily gain (lb.)	2.30	2.81	2.98
Grain per day (barley) (lb.)	—	8.5	12.4
Dressing percentage	54.6	56.2	56.3
Red and Blue grades (%)	15	84	97
Feed costs per lb. gain (¢.)[1]	8.0	10.1	11.3
Total costs per lb. gain (¢.)	15.0	16.3	17.3
Total costs per steer ($)	197.41	211.07	219.92
Selling value per steer ($)	204.47	227.50	235.54
Profit per steer ($)	7.06	16.43	16.62
Profit per acre ($)	17.65	64.07	86.43

[1]Pasture valued at $50 per acre. Grain at 1.8¢. per pound.

Shade should be provided on pasture.



OIL SPRAYS FOR INSECT

H. F. MADSEN

Petroleum oils, once widely used for insect and mite control, are receiving renewed attention because of resistance problems and a rapidly depleting arsenal of effective pesticides. This interest is in no small way due to the effectiveness of oil against spider mites and pear psylla which are destructive pests in nearly all fruit growing areas.

The usefulness of oil as a dormant spray is well established, and has been a standard orchard practice for many years. Alone, or in combination with lime sulphur and organic phosphates, oil has provided control of scale insects, aphid eggs, spider mite eggs, mealybugs, and pear psylla. The oils used for dormant sprays vary in the different fruit growing areas, but are generally oils of high viscosity and low U.R. These oils are unsuitable for summer treatments because they are injurious to leaves and fruit.

Oils which can be used during the foliage season have been under investigation the past few years at the CDA Research Station, Summerland, B.C. These oils are generally referred to as summer oils for lack of a more suitable term. In general, they are narrow cut oils, of low viscosity and high U.R., and are paraffinic in chemical composition. An ideal oil, in terms of present thinking, is one heavy enough to control the pest and light enough to dissipate from plant surfaces within a short time. An oil of this nature would be useful for both dormant and summer sprays.

The mode of action of oils against insects and mites is not fully understood, but it is generally believed that oils kill insects by plugging or interfering with respiratory organs. If this is true then it follows that oils need not be persistent in order to be effective. It also follows that control will be dependent upon good coverage as it will be necessary to contact the pest in order to affect it. The data we have obtained thus far support this hypothesis as the initial kill determines the degree of control obtained.

Dr. Madsen is Head of the Entomology Section, CDA Research Station, Summerland, B.C.

Adult and hardshell stages of pear psylla. Oil will kill these stages on contact.

Oil injury to D'Anjou pear leaves.

OPPOSITE PAGE—San Jose scale on apple, controlled by oil at delayed dormant stage.

In our investigations of oils at Summerland for control of spider mites, we have shown that timing of sprays is a very important factor. A spray applied during the pre-bloom stage on apples has given seasonal control of the European red mite. We have also found that when high populations are present during the summer, two applications 10 to 14 days apart are necessary to obtain control. Our research revealed this is because oil does not kill the moulting stages of the mites nor all of the summer eggs. This is additional evidence that the residual action of oils has little effect on the mites. We have been unable to obtain good control of two-spotted mite and McDaniel mite with oils. This is probably due to the web spinning habit of these mite species which prevents oil droplets from contacting the mites. In our laboratory, where we could make contact with the mites, oils have given control of both McDaniel and two-spotted mites.

The use of oil for pear psylla control is under study at Summerland because the insect is resistant to a wide range of insecticides. We have found that oil kills the adults, nymphal stages, and eggs. Combinations of oil with insecticides such as Guthion have given excellent control in some areas and provided a treatment that is effective against codling moth, pear psylla, and mites. In the Okanagan Valley of British Columbia heavy dormant oils are not recommended for pear psylla control because of adverse effects upon predators. Indications are, however, as revealed by our research, that the newer summer oils are less toxic to predatory insects and can be used during the dormant and delayed dormant periods in place of the heavy oils.

The biggest single factor which, we feel, has discouraged the general use of oils on apples and pears is the problem of phytotoxicity. Injury reports over the years have included premature defoliation, leaf spotting, fruit russet, twig killing and reduction in fruit size. Not all of these reports have been confirmed nor reproduced, and this may be due in part to the variability of oils which were in use during past years.

AND MITE CONTROL ON APPLES AND PEARS

Oil injury to Red Delicious apple twig:
(left) healthy twig; (right) twig containing enlarged and corky lenticels.

Oils can also cause compatibility problems since they act as surface active agents to increase wetting, spreading and penetration. They may increase the hazard of injury from other compounds by dissolving the natural oils and waxes which protect plant surfaces.

In addition to phytotoxicity problems associated with direct combinations, we have found that oils were involved in injury when certain insecticides follow an oil spray. We have noted adverse effects up to an interval of 30 days or more between applications. Why this occurs is not understood, but there are two possible explanations. Firstly, the oils may remove protective waxes from foliage and fruit allowing the insecticide to contact susceptible tissues. Secondly, an oil deposit may still be present and react with the pesticide to produce a phytotoxic effect. That oils are persistent has been shown by chemical analysis. Recent studies on a superior type summer oil have shown that oil deposits on foliage diminish slowly, and after three weeks better than 50 per cent of the original deposit remains.

One problem we have met with many of the currently available oils is that they are not narrow cuts, but blends of heavy and light fractions. The light fractions dissipate rapidly, but the heavy fractions remain on the plant surface where they may interfere with leaf functions and react with other pesticides. Some of the more recent summer oils are approaching the uniform, less persistent type, but there is still much to be learned about their effectiveness and hazards. For example, our trials over several seasons have shown that one of the new summer oils (vis. 70-75 S.S.U. at 100°F.) is more effective against European red mite eggs than the standard dormant oil (vis. 200-215 S.S.U. at 100°F.) We have noted, however, that bark injury was present in the form of enlarged and corky lenticels on Red Delicious trees sprayed with the summer oil. It is not known if this effect is detrimental, but it indicates caution in suggesting the use of this oil to growers.

Oils present many problems but they have certain advantages as well. We believe, however, that they may fit into an integrated program of pest control if they are shown not to adversely affect natural enemies. There is no toxic residue problem, and they are safe to handle. If their mode of action is physical rather than chemical the problem of resistance may not be acute. We are continuing research on the use of oils, especially as foliage sprays, in the hopes they can be used both safely and effectively. ●

EAR TO THE GROUND

INTERESTING RESEARCH HIGHLIGHTS

After-harvest spraying to control stinkweed and flixweed:

Left: untreated. Right: sprayed with 6 oz./A 2,4-D ester.

AFTER-HARVEST SPRAYS CONTROL WINTER WEEDS . . . After-harvest spraying for control of winter annual stinkweed and flixweed has been highly successful in Southwestern Saskatchewan, says H. C. Anderson, of the Research Branch, CDA, Swift Current, Sask.

Fields sprayed with 6 oz. per acre of 2,4-D ester in October, 1964 contained completely clean stands before fallow operations began in June, 1965. Similar results were obtained at the Pambrum and Gull Lake Project Farms. Late fall spraying made it possible to delay the first summerfallow operation well into June. Thus, there was no need for early spraying or cultivation for weed control on fallow land.

The purpose of the present experiment is to minimize cultivation of the soil in an effort to conserve trash and moisture. In this way, it is hoped to maintain fertility and prevent wind erosion.

CAN SOLONETZIC SOILS BE IMPROVED? . . . Dr. R. R Cairns, Officer-in-charge, CDA Solonetzic Soil Sub-Station, Vegreville, Alta., reports that their investigations give some indication that long-term improvement of solonetzic soils may be wrought by stimulated crop production. He has already reported (*RFF Summer '63*) that when large amounts of nitrogenous fertilizers were applied to a test strip of bromegrass grown on solonetzic soil, yields were much greater than from an adjacent fertilized strip.

Here's what happened when 600 lb. of elemental nitrogen (16-20-0) were applied to the fertilized strip during each of the three years 1961 to 1963 inclusive:

The average annual yield per acre was about 7,000 lb. while the unfertilized strip yielded only about 2,800 lb. In 1964, the second lowest rainfall in 60 years, from October to July, caused a severe drought. The fertilized strip yielded 3,000 lb. dry matter that year, and the unfertilized strip only 865 lb. Dr. Cairns explained that much more fertilizer was used than necessary for substantial production, but that this was done purposely to get the most possible growth.

When, during 1964, soil was sampled to a 30-inch depth to study the distribution of crop roots and water removal, it was found that there were 11,500 lb. of roots per acre in the top 6 inches of soil under the fertilized strip, but only 7,000 lb. under the other strip. But below this depth, there was almost the same quantity of roots under both treatments. Even so, reports Dr. Cairns, 300,000 lb. more water per acre was removed from the 6- to 30-inch soil depth of the fertilized strip between May 7 and July 10. Considering the low rainfall, and the greater volume of water removed during this period Dr. Cairns says it can be assumed that the fertilized strip produced 2.55 lb. dry matter per 1,000 lb. of water, compared with 0.90 lb. from the unfertilized strip.

The study is being continued, Dr. Cairns advises, with special emphasis upon any effect stimulated crop growth may have on salt movement within the soil.

PAPER CELLS FOR TRANSPLANTING SEEDLINGS—A technique for the production of paper cups for grass and legume seedlings has been used for 20 years with considerable satisfaction at the CDA Research Station, Saskatoon, Sask. Dr. R. P. Knowles of the station explains the method:

Regular greenhouse flats are filled with cells made from newspaper. Cells are $\frac{3}{4}$ inches in diameter and $2\frac{3}{4}$ inches deep with a total of 260 cells per flat. Two galvanized iron sheets, slotted at $\frac{3}{4}$-inch intervals, form a framework to assist in placing cells in the flat.

Two additional metal strips are advanced step by step across the flats, with a row of cells being inserted progressively as these metal strips are moved. An experienced man can prepare a flat in 1 hour. When a flat is filled all metal strips are withdrawn.

Strips of paper may be inserted crosswise in flats after they have been filled with cells. This allows a handy separation of cells within flats. Strains for replicated tests frequently are randomized in flats for later transplanting with a machine transplanter in the field. Soil is not placed in flats until they are ready to use.

Heavy rates of fertilization are required.

FORCED MOULTING OF LAYING BIRDS—In view of a possible shortage of replacement pullets this fall following the recent low egg prices, egg producers have become interested in the economics of returning birds to lay after a forced moult. Thus observations from an eight-month study recently completed at the CDA Research Station, Agassiz, B.C., on a portion of the 1963 population are particularly timely:

1. The size of eggs from forced-moulted birds was consistently greater than from pullets of the same stock. 2. The internal quality of eggs from forced-moulted birds was consistently poorer than that of eggs from pullets of the same stock. Even though pullet eggs were smaller, their superior interior quality resulted in their being worth more per dozen. 3. Deterioration in market quality of eggs following storage on the farm was noticeably greater in the case of forced moulted birds. 4. Production of eggs from the forced moulted birds peaked at 70% whereas the same birds as pullets peaked at 85%. Mortality stood at approximately 6% for both populations. These data were based on replicated pens.

Tables are currently being prepared to provide egg producers with factual information on which to plan their fall replacement program.

NEW BIRDSFOOT TREFOIL STRAIN DISCOVERED—A promising new strain of birdsfoot trefoil is being studied at the CDA Experimental Farm, Nappan, N.S., reports Dr. F. S. Warren of the farm. He says that when it was discovered two years ago, growing as a vigorous stand in an abandoned pasture near Wallace, N.S., forage specialists selected plants from it and harvested seed in the area.

Preliminary tests indicated that it had different growth habit and hardiness from the common varieties, and apparently a good potential. However, its most desirable feature is good competitive ability. This should make it much more useful than present-day varieties for pasture in Eastern Canada.

Last winter an increase block in a growth room yielded 197 grams of seed. From this, enough seedlings were grown to plant nearly $\frac{1}{2}$-acre, to provide additional seed for experimental purposes.

Small samples were sent to birdsfoot trefoil breeders across Canada, and further comparative tests were established at Nappan.

BROILER PRODUCTION AND MARKETING TEST—The CDA Experimental Farm, Agassiz, B.C., and the Poultry Science Department of the University of British Columbia recently completed a joint broiler production and marketing test involving white vs. yellow-skinned broilers. Here are the results:

At 8 weeks, W. S. females avaraged 3.30 lb. and W.S. males 4.18 lb. on 2.07 lb. of feed. Y.S. females averaged 3.33 lb. and Y.S. males 4.18 lb. on 2.03 lb of feed. When marketed at 9 weeks and 4 days, the W.S. birds averaged 4.60 lb. on 2.32 lb. of feed and the Y.S. birds 4.57 lb. on 2.30 lb. of feed. Percent grade A were 82 for W.S. and 86 for Y.S. Condemnations were 0.2% for W.S. and 0.4% for Y.S.

When these birds were marketed through a number of chain stores in Vancouver, the Poultry Science Department at the University of British Columbia found that 56% of the shoppers preferred a white skin color and 17% a yellow skin color. The remaining 27% of the shoppers had no preference for either color. It was noted that those preferring white-skinned birds would usually not accept yellow birds even if the white ones were not available, but those preferring the yellow ones would take the white. It was also emphasized that the project concerned only fresh or ice-packed broilers. Conclusions reached must be considered tentative as the sample of consumers was limited.